Session 739 - Transcranial Magnetic Stimulation

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739.08 - Neural effects of theta-burst Transcranial Magnetic Stimulation on single neurons in macaque parietal cortex

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Abstract
Theta-burst transcranial magnetic stimulation (TBS) has recently received much interest because it can be used to up- or downregulate brain activity non-invasively for up to an hour, by a mechanism thought to rely on synaptic plasticity. However, a major issue with TBS is that its behavioral effects are highly variable. A better understanding of TBS effects on different populations of neurons is currently needed to improve its reproducibility. Recently we have recorded single-unit activity in parietal cortex during and after single-pulse transcranial magnetic stimulation (TMS, Romero et al. Soc Neurosci abstract 2016) and found that single-pulse TMS (120% of resting motor threshold) induces a short-latency burst of action potentials in parietal neurons lasting on average 80 ms. Here, we measured the after-effects of continuous TBS (cTBS, 300 pulses) on the TMS-induced burst and spontaneous neuronal activity. Guided by anatomical MRI, we recorded single-cell activity in parietal area PFG in one macaque monkey during passive fixation of real-world objects. We compared trials with and without cTBS (60% of resting motor threshold). In each recording session, we first searched for well isolated single neurons, then ensured we could record stable TMS-evoked bursts before cTBS. If a TMS-evoked response was found we proceeded with applying cTBS, after which we immediately resumed the single-pulse TMS protocol to assess changes in excitability up to 50 minutes after the start of cTBS. On average, cTBS caused a robust reduction (29%, $p<0.001$) in the TMS-evoked population response, which peaked in the 20 to 30 min post-cTBS time interval. This decrease in excitability following cTBS recovered to nearly normal values in the 40 to 50 min post-cTBS interval (5% reduction, ns). Overall, 97% of all cells recorded showed significant reduction in the TMS-evoked response. Interestingly the temporal dynamics of this effect differed strongly between neurons. 48% of the neurons showed early cTBS effects (0-5 min), whereas 44% were not affected in the first 5 min but were inhibited in the 5 to 30 min post-cTBS interval. The remaining 8% showed very late inhibitory effects (>30 min). In addition, we found a significant reduction in the average spontaneous activity (31 %, $p<0.001$), which persisted throughout our recording session (up to 50 min). Our results confirm that cTBS causes long lasting inhibition in PFG neuronal activity which peaks 20 to 30 minutes after stimulation. Further investigating how different neuronal populations respond with a specific time course might reveal the mechanisms of early stage synaptic plasticity mediated by cTBS. Supported by FWO, Odysseus, and PFV/10/008